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and glazed, but found the Glas to flow more inequality than I expected, though the Potter tells me 'twas caused by the Foulness of the Earth I used.

VII. Part of a Letter of Mr. Anthony van Leeuwenhoeck, dated Delft, Sept. 10. 1697. Concerning the Eggs of Snails, Roots of Vegetables, Teeth, and Young Oysters.

MR. *Friderick Walfert* from *Overfchie*, about Two Years ago brought me some little White Round Eggs, mixt with dry Earth, in which Earth the Eggs were found, and whose Axis was almost the Fifteenth Part of an Inch, together with a Desire to inquire what living Creature would come out of them.

I did separate some of these Eggs, and found a thin Moisture in them, mixt with round Bubbles; the rest of the Eggs I included in a Glas, but the internal Matter dried in a few Days away, and the White Membrane of the Eggs (which was very tender and soft) wrinkled together, by drying away the Moisture, so that no living Creature did come out of them.

The Year following, the fore-mentioned Friend brought me again some of these Eggs, with which I did as before, but I did not get any thing out of them.

Now in the begining of the Month of *July*, the same Friend brought me a greater Quantity of these Eggs, that was mixt with a Handful of wet Earth.

In the mean time it came into my Mind, if the drying away of the Moisture of these Eggs was not the Reason of their not bringing forth a living Creature, because the Eggs being in a dry Earth, grew fruitless, and that the Nature of those Eggs required a moist Earth, and for that Reason.

Reason by the first managing I got no living Creature out of the first Eggs.

Therefore I resolv'd to pick out the Eggs of the Earth, and to mix them with a part of the moist Earth, in which they lay before, and put them up in a Glass Tube, Hermetically seal'd together on one end, and which I stopt at the other end with a Cork, for to hinder the Moisture from drying away from the Earth, but that it must collect it self again on the Glass, and drop down again to the Earth, and thus the Eggs should not want Moisture.

Having done this, I laid the mentioned Tube upon my Table, and looked upon it several times, and after few Days, I saw in Two different Places in the Glass something growing, being Green, and to my Fancy like Grass, the Root of which I observed as much as possible, together with vast Quantities of the little Roots that came out of the bigger one, being about Four times as big as the Hair of ones Head; yea, the Number of the Number of these little Roots was at last so great, that it would be scarce credible.

This mentioned thicker Root, did consist of a great many very thin little Pipes, which Pipes had again their little Parts very like those of the Straw or Reed.

I could not think but these Vegetables was come forth from Seeds of Grass, that hath been in the Earth.

Now on the Second of *August* I saw to my Wonder Two little Horn Snails, which we call *Wine-yearnt Snails*, sitting against the Glass, having crept away from the Earth, for I had fill'd the Glass only half full with the Earth and these Eggs, and its length was about Ten Inches, and its inner Space about Two Third Parts of an Inch.

Farther, I took out of the Glass Tube an Egg, or rather a Snail, on which a part of the Skin of the Egg was

left, and I put it in a thinner Glass for to look upon it more nicely, with a Microscope. And when I look'd upon it, I observed a continual Motion in a Vessel, whose Thickness was to my Judgment about the Fourth part of a Hair of ones Head.

This Motion was not by a running through, but every time returned with a quick Motion, and this so soon after one another, that the Juice which was fore'd through that Vessel, received at least Three Pulsations in the same Space, when the Heart in a Humane Body sends forth the Blood once.

By this Propulsion I concluded with my self, that it was an Arterie of this Animal, and that this Vessel was not far from the Heart.

For I did Fancy, if the said Vessel was far from the Heart, the Repetition of a quick Motion could not be discern'd by me so distinctly and well.

The other Morning the Snail was dead, only, as I did think, for want of Food; for the other Snails of the same Age, which I left in the Glass with the Earth, were alive.

The Second Day there was more Snails come out of the Eggs, and the Third Day more again.

I did look several times upon a Snail, in manner as it fate inwards, against the Glass, and to my great Satisfaction, I could see through the Shell and part of the Snail, which to my Judgment was not bigger than an ordinary Grain of Sand, having the Figure of a common Egg.

The Body of the Snail was partly retracted and extended again, which Motion happened in as little time, as we may easily pronounce a Word of Four Syllables.

Seeing this, it came into my Mind, if this moving Body was not the Lungs of the Snail, which by the Respiration was put into such a Motion.

I have dissected several times before the Wine-yard Snail, and that of the biggest sort I could meet with, for to (if it were possible) inquire into its Generation, and to find the Young Ones in its Belly; but it has been always in vain, and now their Generation out of an Egg, comes by Chance, and without great Trouble to my Sight.

I have many times wondred in the Spring, to see those little Snails so early on the Knops and Branches of the Vine, because I could not imagine, that the Snails should have brought forth these Young Ones so early in the Year. But now we see, that they come forth out of Eggs, and thus we can easily comprehend that these Eggs lay in the Earth all the Winter along, and by the first warm Weather are hatched.

I have also seen several times, that the Shells of the greatest sort of the Wine-yard Snail, hath been thus infected as if they had been under the Ground, in which I could never satisfy my self: But now since we know that these Snails lay their Eggs in the Earth, they consequently must creep under the Ground themselves, this being thus, we have no more Reason to wonder by seeing the Shell of the Wine-yard Snail thus covered and infected with Earth and Slime.

This may look a little Strange to some, that the Wine-yard Snail should creep into the Earth, but not after they have had Experience, the like to it hath happened several times to me, viz. That the wine-yard Snail lying upon the Ground, having pressed it with the Heel of my Foot into the Ground, after a little while it got it self out again, (if the Shell is not broke.)

Therefore we see (as it is said before) that the Generation of the Wine-yard Snail happens by Eggs, the old Opinion is consequently to be laid aside, viz. That the Snails come forth by the spoil'd and rotten Leaves of Trees.

Trees, and that the Leaves of Trees, left on the Ground, produce Snails.

But we shou'd rather think, that when we in *Autumn* leave the Leaves of Trees lying on the Ground, the Eggs of Snails lying in the Earth where these Leaves lye, are better defended from the hard Cold, than those which lye where no Leaves are.

As soon as I did meet with the forementioned Friend, from whom I had received these Eggs (which was on the 4th of *August*) I did not only tell him after what manner I had managed these Eggs, but I also invited him to come to see the Snails that was come out of the Eggs, which he likewise did; being more perswaded, that out of these Eggs should come forth what we call *Agediffen*.

The following Day the same Friend brought to me one of the greatest Wine-yard Snails, which he had found on the same place where he found the Eggs before.

This Snail had upon its Shell some wet Earth, in the same Condition just as if they were come out of the Ground.

This Snail he took up, and saw that the Snail brought forth one Egg more, and shew'd me the Place where the Egg came out.

As soon as I was Master of the Snail, I put it up in a Glass Tube, being so large that the Snail could turn it self in it, and about Ten Inches long.

The Snail had not been there half an Hour, but it had brought forth on the Glass Seven Eggs, and about Two Hours after, Seven Eggs more, and when I looked on it again; I found that the Snail by creeping up and down had broken all the Eggs in the Glass; so that there could be nothing discerned, except the Membrane of the Eggs.

This

This great Snail died on the Second Day, in all likelihood for want of Food, without getting any Eggs from it.

The Young Snails, which was come out of the Eggs, did not live above Two or Three Days, which being dead, I took them out of the Glas, and observed, that the Membrane out of which the Snails was come, was extraordinary White, and the rest of the Eggs, which were fruitless, and out of which there was no Snail come, had a dark waterish Colour.

I have told before of a great many little Roots, that was come out of a Root of Grass; now to observe, if such a Quantity would come out of another Plant, I got a Glas Tube, of near half an Inch Diameter, and Three Inches in Length, which Tube I sealed up in one end, and fill'd up with dry Sand, to more than Two Third Parts, and pour'd over it Rain Water, to wet the Sand quite through; afterwards I stamp't the Sand somewhat close together, for the Reason that it should not fall so soon asunder by moving and handling the Glas Tube.

Having done this, I made Three Holes in the upper part of the Sand, and in each Hole I laid a *Taruw-greyntge* which came to lye even with the Sand with that Part where the Plant was; for the Reason that the Roots which should come out, should not be covered with Sand, when the upper Part of the Glas Tube had been shut up with Cork.

This Glas being thus prepared, I carried in my Pocket for Four or Five Days, and afterwards observed, that the *Taruwutge* did begin to get Roots.

On the Seventh Day the Roots of one *Taruwutge* (of which was three, but one longer than the other) was grown, and thus far, that I could see very distinctly, that they did consist of very thin Pipes, every Pipe having

having its small Parts very like the same which I told you before was come out of the Roots of Grass,

The Diameter of these Roots was, to my measuring, very near the Sixtieth Part of an Inch, and their outmost end run sharp too, almost like the Bill of a Bird.

About the length of Three or Four Diameters of the Root, the Root was even and smooth, without any Roots coming forth, but when we look'd a little nearer the *Taruw* we saw little Roots coming forth, which was the longer the nearer they were to the *Taruw* but they were all of the same thickness.

The Eighth Day, that part on the Side of the *Taruw* where the Plant was to come out, was grown out to the length of Two Third Parts of an Inch; by which growing of the Plant, and its touching or pressing against the Sand, the *Taruw* that was without the Sand, was pull'd up, and the longest Roots, of which one of the Length of more than an Inch touching the Cork, turn'd crooked.

I took the Cork from the Glass, by which one of the Roots came out of the Glass, upon which I lookt upon it by a Microscope, for to see the better the small Parts on such a thin Root, if it were possible, and if there should be any.

I did think that I could see into some, but when I had a mind to look upon them more nicely, the Moisture of the Root was dried away, and it was wrinkled irregularly together, as well in length, as in thickness.

This drying away happen'd in less than half a Minute's time.

The foresaid little Roots was in such a great Number, that if I would make the Calculation, those of the length of an Inch would make an unimaginable Number.

Now what belongs to the thickness of these very thin Roots, I judge, to my best measuring by the Eye, that where the Diameter of a thin Root was one, the Diameter

ter of the thicker, out of which the little one came forth, was Twenty, and by that Consequence, Four Hundred such thin Roots together, were as thick as the Root out of which they all came forth.

Now as 60 Diameters of the first Root make out 1 Inch, and 20 Diameters of the second Root make 1 of the former, it follows, by the Rule of Geometry, that 3600 of the first Roots make 1 Inch.

These 3600 being multiplied with 400, there comes out the Number 1440000 of thin Roots, which together, make up the thickness of 1 Inch.

This being thus, we cannot wonder, when by taking out a Plant of its Ground, these little Roots which are invisible to our Eyes, almost all of them are broken off, because they are always inclosed with wet Earth or Sand.

After these thin Roots, which were come forth, had been in the Glass for Three or Four Days, without touching the Sand or the Glass, but only in the free Air that was in the Glass, I observed, that these Roots did dry up, and grew irregular and wrinkled together.

I cannot forbear telling you that I had again a Tooth in my Mouth, which being moveable, did hinder me very much in eating, I did design to press hard against it with my Thumb, in mind to pull the Roots of the Tooth out of the Flesh, and thus to get rid of the Tooth, likewise it did succeed, because the Tooth was left fast only by a little Part to the Flesh, which I could separate easily.

The Top of that Tooth was almost gone, and its Root did consist of Two Branches, which was likewise extraordinary whole, and filled up with a soft Stuff.

I took out this Stuff of the Roots, and mixt it with fair Rain Water, and put it thus before the Microscope, to see if there were living Animals in it, as I had observed before in the like stuff, and I must confess, that the whole Stuff seemed to be alive, and the Number of these Animals was very great, and besides this, so little, that some of them, with a Thousand Millions of others, would not make up a great Sand Corn, and there swam already some Thousands in a Quantity of Water, no bigger than a great Sand, and the Number seemed bigger than it was really, because the Animals swimming so quick in the Water, did move a great many Particles without Life, in a manner, that many would have taken these Particles to be living Creatures.

Farther, being on the Third of *September*, at *Rotterdam*, and coming about Noon to a House of one of my Kinsmen, I was treated with English Oysters, come the same Morning from *Zealand*, of which Oysters I opened about 25, amongst which there was one that was not thought Good, because there was to be seen a great deal of Slime. For when I did hold the Oyster thus that the round part of the Shell came next to me, there was the Breadth of the Oyster, against my Right Hand almost covered with Grey Stuff, which any Man would certainly have thought to be Slime. But it came into my Mind that it was Young Oysters, and for that Reason I took a little of it between my Fingers, for to try if I could find what stuff it should be.

I did feel something that was sharp between my Fingers, but this could as well have been fine Sand, therefore I would not give my Judgment about it, but laid a part of the thought Slime between Paper, and when

I was come home look'd upon it by a Microscope, and saw, that all that imagined Slime was nothing but Young Oysters, and though afterwards 25 Oysters more were opened in my Presence, yet I could not find one more, in which was such a Slime, or rather, Young Oysters could be seen, by the natural Eye. So that we see hereby again, that one Oyster bringeth forth its Young ones much later than the other.

T O U R S, &c.